

WHAT IS CLAIMED IS:

- 1 1. A method of reconstructing optical tissues of an eye, the method
2 comprising:
 - 3 transmitting an image through the optical tissues of the eye;
 - 4 measuring surface gradients from the transmitted image across the optical
 - 5 tissues of the eye; and
 - 6 applying a Fourier transform algorithm to the surface gradients to reconstruct
 - 7 a surface that corresponds to the optical tissues of the eye.
- 1 2. The method of claim 1 comprising aligning the reconstructed surface
2 of the optical tissues of the eye with an image of the eye that was obtained during the
3 measuring of the surface gradients.
- 1 3. The method of claim 1 or 2 comprising computing a correction
2 ablation pattern based on the optical tissues of the eye as indicated by the Fourier
3 reconstructed surface.
- 1 4. The method of claim 3 wherein computing a correction ablation pattern
2 comprises deriving a proposed change in elevations of the optical tissue so as to effect a
3 desired change in optical properties of the eye.
- 1 5. The method of claim 4 further comprising modifying the optical tissue
2 surface according to the correction ablation pattern by laser ablation.
- 1 6. The method of claim 1 further comprising adding a mean gradient field
2 to remove a tilt from the reconstructed surface.
- 1 7. The method of claim 1 wherein measuring the surface gradients
2 comprises uniformly sampling the transmitted image over an aperture.
- 1 8. The method of claim 7 wherein the aperture is a pupil of the eye.
- 1 9. The method of claim 1 wherein measuring surface gradient data is
2 carried out with a Hartmann-Shack sensor assembly.
- 1 10. The method of claim 1 wherein the surface is a wavefront surface.

1 11. The method of claim 1 wherein applying a Fourier transformation
2 comprises applying a discrete Fourier decomposition and an inverse discrete Fourier
3 transform.

1 12. The method of claim 1 wherein the Fourier transformation uses all of
2 the available information in the reconstruction.

1 13. The method of claim 1 wherein applying the Fourier transform
2 calculates a tomographic wavefront error map of the optical tissues of the eye.

1 14. The method of claim 1 wherein the image is transmitted by the optical
2 tissues as a plurality of beamlets, wherein the surface gradients comprise an array of
3 gradients,

4 wherein each gradient corresponds to an associated portion of the optical
5 tissues of the eye, wherein each beamlet is transmitted through the optical tissues according
6 to the corresponding gradient.

1 15. A method for measuring optical tissues of an eye, the method
2 comprising:

3 transmitting an image through the optical tissues;
4 determining local gradients across the optical tissues from the transmitted
5 image; and

6 mapping a wavefront error of the eye by applying a Fourier transform
7 algorithm to the surface gradients across the optical tissues of the eye.

8 16. The method of claim 15 further comprising adding a mean gradient
9 field to the wavefront error to correct for tilt.

1 17. The method of claim 15 wherein determining local gradients across the
2 optical tissues is carried out by a Hartmann-Shack sensor assembly.

1 18. The method of claim 15 comprising creating a laser ablation treatment
2 table based on the mapped wavefront error of the optical tissues of the eye.

1 19. The method of claim 18 comprising modifying the optical tissue
2 surface according to the correction ablation pattern by laser ablation.

1 20. A system for measuring a wavefront error of optical tissue, the system
2 comprising:
3 a processor;
4 a memory coupled to the processor, the memory configured to store a plurality
5 of code modules for execution by the processor, the plurality of code modules comprising:
6 a module for transmitting an image through the optical tissues;
7 a module for determining local gradients across the optical tissues from
8 the transmitted image; and
9 a module for mapping a wavefront error of the eye by applying a
10 Fourier transform algorithm to the surface gradients across the optical tissues of the eye.

1 21. The system of claim 20 further comprising an image source coupled to
2 the processor for transmitting a source image through the optical tissues of the eye.

1 22. The system of claim 20 further comprising a wavefront sensor system
2 coupled to the processor.

1 23. The system of claim 22 wherein the wavefront sensor system
2 comprises a Hartmann-Shack sensor assembly.

1 24. The system of claim 20 wherein the code modules further comprise a
2 module for computing a correction ablation pattern based on the optical tissues of the eye as
3 indicated by the Fourier reconstructed surface.

1 25. A laser system that is in communication with the system of claim 24
2 wherein the laser system comprises a laser that is programmable to deliver a laser energy to
3 the optical tissues according to the correction ablation pattern.

1 26. The system of claim 20 further comprising a camera to track the
2 position of the optical tissues,

3 wherein the code modules further comprise a module for registering the
4 wavefront error relative to the optical tissues.

1 27. The system of claim 20 further comprising an adaptive optical element
2 that is coupled to the processor.

1 28. The system of claim 27 wherein the adaptive optical element is a
2 deformable mirror.

1 29. A computer program stored on a computer-readable storage medium
2 for measuring optical tissues, the computer program comprising:
3 code for transmitting an image through the optical tissues of the eye;
4 code for measuring surface gradients from the transmitted image across the
5 optical tissues of the eye; and
6 code for mapping a wavefront error of the eye by applying a Fourier transform
7 algorithm to the surface gradients across the optical tissues of the eye.

8 30. The computer program of claim 29 further comprising code for
9 computing a correction ablation pattern based on the optical tissues of the eye as indicated by
10 the Fourier reconstructed surface.

1 31. The computer program of claim 30 further comprising code for
2 delivering a laser energy to the optical tissues according to the correction ablation pattern.

1 32. The computer program of claim 29 further comprising code for
2 aligning the mapped wavefront error with an image of the optical tissues of the eye.

1 33. A system for measuring optical tissues of an eye, the method
2 comprising:
3 means for transmitting an image through the optical tissues;
4 means for determining local gradients across the optical tissues from the
5 transmitted image; and
6 means for mapping a wavefront error of the eye by applying a Fourier
7 transform to the surface gradients across the optical tissues of the eye.

1 34. The system of claim 33 further comprising means for computing a
2 correction ablation pattern based on the optical tissues of the eye as indicated by the Fourier
3 reconstructed surface.

1 35. The system of claim 34 further comprising means for modifying the
2 optical tissue surface according to the correction ablation pattern by laser ablation.